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Association between Self-Reported Fatigue and Sarcopenia Measures among Elderly in Selangor, Malaysia

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Abstract

The association between fatigue and sarcopenia is not well understood, therefore, this study aimed to compare the sarcopenia measures among elderly with mild and severe fatigue and to determine whether fatigue severity is associated with sarcopenia measures. This was a cross-sectional study conducted on 201 elderly (age = 68.45±6.30 years). The elderly was classified into either mild or severe fatigue based on the Fatigue Severity Scale (FSS), meanwhile, sarcopenia measures include SARC-F score, muscle mass (ASM/height^2), calf circumference (CC), upper (handgrip) and lower limb muscle strength, as well as physical performance (gait speed). Data were analyzed using independent t-tests and logistic regression. The results showed that elderly with severe fatigue were significantly older, with lower muscle strength, and slower gait speed (all p-value <0.05). After adjusting for age, fatigue severity remained significantly associated with SARC-F score (OR = 1.583, 95% CI = 1.262-1.986, p-value = 0.001) and CC (OR = 1.103, 95% CI = 1.014-1.200, p-value = 0.022). Moreover, when the SARC-F score was removed from the regression model, fatigue severity was significantly associated with CC (OR = 1.088, 95% CI = 1.006-1.178, p-value = 0.036) and gait speed (OR = 0.011, 95% CI = 0.001-0.168, p-value = 0.001). Based on the results, fatigue severity is associated with SARC-F score, CC, and gait speed, therefore, interventions targeted at sarcopenia measures is recommended to optimize physical endurance in the elderly.

Keywords: elderly, fatigue, Malaysia, muscle strength, sarcopenia

Introduction

Fatigue is a common self-reported distressing symptom, perceived as a lack of energy or a feeling of exhaustion accompanying the aging process,[1] it affects more than 20% of the community-dwelling elderly.[2,3] Meanwhile, sarcopenia is defined as a generalized muscle weakness which may have a role in the development of fatigue in the elderly. Globally, sarcopenia shows some tendencies toward a greater use or burden on healthcare resources in the population,[4] due to its potential association with fatigue and malnutrition,[5,6] which results in poor life quality and frailty syndrome in the long run.[7]

Previous findings on the association between fatigue and sarcopenia were inconsistent as different assessment tools have been used. For instance, a population-based study in Brazil found that self-reported fatigue using the Centre for Epidemiologic Studies-Depression (CES-D) Scale was associated with physical performances as indicated by the Short Physical Performance Battery (SPPB) and normal gait speed after adjusting covariates.[3] In contrast, another study reported no association between fatigue and any criteria used to define sarcopenia.[8] In the latter study, fatigue symptom was assessed by inquiring "In the last week, how many times have you felt that everything you do is an effort?" with four possible answers: (a) rarely, (b) few times, (c) occasionally, and (d) most of the time. The lack of association is probably due to the use of inadequate assessment, sufficient to operationalize the perception of fatigue in the elderly.

Furthermore, a study found no significant differences in self-reported fatigue among non-sarcopenic and sarcopenic patients with osteoarthritis and rheumatoid arthritis. In the study, fatigue was measured using the Multidimensional Assessment of Fatigue and Visual Analog Scale.[9] Besides, the sarcopenia status of the participants was diagnosed based on the appendicular skeletal muscle mass (AMI), meanwhile, based on the results, there was no significant association with self-reported fatigue or physical function.[9] Self-reported fatigue assessment using Fatigue Severity Scale (FSS) might be a better option for the elderly as the scale measures the severity of fatigue and its effect on individual activities and

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lifestyle with 9-items.[10] Furthermore, the FSS has been reported to have low floor and moderate ceiling effects.[11] In comparison, the CES-D scale is related to symptoms associated with depression,[12] while the Multidimensional Assessment is a 16-item scale and might take a longer time to be completed.[13]

Recently, the European Working Group for Sarcopenia in Older People (EWGSOP),[14] and the Asian Working Group for Sarcopenia (AWGS),[15] suggested that measures of sarcopenia includes finding cases using the SARC-F questionnaire, muscle mass (MM), and strength, as well as physical performances. Also, AWGS suggested that sarcopenia is also determined by measuring the calf circumference (CC) as a proxy for MM in the absence of other tools.[15] Identifying which measures influence the severity of fatigue using a more practical assessment scale is important as it promote rehabilitation for the elderly with physical intolerance especially when performing daily activities. This study aimed to compare the sarcopenia measures among elderly with mild and severe fatigue and to determine whether fatigue severity is associated with sarcopenia measures.

Method

This was a cross-sectional study conducted on 201 community-dwelling elderly aged 60 years and above from 10 selected villages in Selangor from November 2019 to January 2020. Meanwhile, Selangor was selected because it is one of the states with the highest elderly population in Malaysia.[16] Participants were included depending on the ability to understand Malay or English as well as verbal instruction, and provided the Mini-cog score is above four.[17] In addition, participants with severe hypertension (systolic blood pressure >180 during screening or recruitment), unable to understand the study procedure, with underlying medical problems, and undergone surgical procedure (less than six months before screening) were excluded. Eligible participants completed the questionnaires for biomedical examination and socio-demographic profile, meanwhile each participant was required to sign an informed consent before data collection while an ethics approval was obtained from the Research Ethics Committee of Universiti Teknologi MARA (Approval No. REC/493/19). Besides, data such as age, gender, and health history were gathered through self-reported or assisted questionnaires. Bodyweight was measured by a calibrated scale, and height was assessed with a measuring tape fixed on a wall.

The Fatigue Severity Scale (FSS) was used to assess the participants' level of self-reported fatigue consisting of 9-item in relation to how the level of fatigue causes disturbances in physical function, continuous physical, work, or social activities. The minimum possible score is 0, while the maximum possible score is 63. Moreover, the participants were categorized into mild and severe fatigue based on the cut-off score >36, which indicates severe fatigue.[18]

Based on the AWGS algorithm recommendation,[15] the following sarcopenia measures were included SARC-F questionnaire, muscle mass (MM), calf circumference (CC), upper (handgrip), and lower limb muscle strength, as well as physical performance (gait speed). The SARC-F questionnaire is a series of questions on capability, and difficulty in performing specific tasks such as lifting and carrying objects weighing 10 pounds, walking across a room, transferring from a chair to a bed or vice versa, climbing a flight of ten stairs, and the number of falls in the previous year. Furthermore, the scores is graded as 0 having no difficulty, 1 as having some difficulty, and 2 as a lot of difficulties to perform the task. A score of ≥4 indicates the possibilities of sarcopenia.[19]

The bioimpedance analysis was used to assess MM by measuring the appendicular skeletal muscle mass (ASM) and recorded in kg. Thereafter, the score was then converted to appendicular skeletal muscle index (ASMI) [ASM/height^2 (kg/m^2)]. The cutoffs for low MM in sarcopenia diagnosis were as follows, <7.0 kg/m^2 in male, and <5.7 kg/m^2 in female.[15] Besides, CC was measured using a non-elastic tape on both calves in a standing position. The score was recorded based on the highest value of either side of the calves. Meanwhile, cut-off values of <34 cm and <33 cm were used for male and female respectively, for possible sarcopenia.[15]

Handgrip strength was assessed to determine the upper limb (UL) muscle strength using a Jamar hand-held dynamometer. The participants were positioned in sitting position with the elbow in 90° flexion, while the wrist and forearm in a neutral angle. Participants were asked to grip (with the dominant side) the dynamometer as strong as possible for three trials with a 1-min rest interval.[20] The score was recorded based on the best performance among the trials. The cut-off points for grip strength were <28 kg and <18 kg for male and female respectively for possible sarcopenia.[15] The lower limb (LL) strength was measured using the Five Times Sit-to-Stand Test (FSTS) while the time taken to complete the test was recorded. When participants takes more than 12 seconds to complete the task, this indicate possible sarcopenia.[15]

Physical performance was evaluated based on the normal gait speed (m/s) using the 4-meter walk test (4MWT). The participants performed 8-meter walk with 2-meter for the acceleration phase and another 2-meter for the deceleration phase. Moreover, the time taken was noted when participants have passed through the first 2-meter and stop before the last 2-meter, hence, measuring only 4-meter.[21] The cut-off for gait speed was <1.0 m/s, indicating possible sarcopenia.[15]

Statistical analysis was carried out using SPPS

Version 25 (IBM Corp., New York, USA). Meanwhile, the independent t-test was used to compare the characteristics and sarcopenia measures between participants with mild and severe fatigue. The multivariate logistic regression was performed to test the association between self-reported fatigue and sarcopenia measures based on three models. Model 1 was the unadjusted model, Model 2 was performed by adjusting age, while Model 3 was carried out by removing the SARC-F score from the model but with age-adjusted. All statistical significance was set at p-value <0.05.

Results

A total of 201 elderly were recruited for this study with a mean age of 68.45±6.30 years. Meanwhile, 57 (28.36%) elderly were found to report severe fatigue. Comparisons among elderly with mild and severe fatigue in terms of age, anthropometric data, and sarcopenia measures are shown in Table 1. Participants that reported severe fatigue were significantly older with heavier weight, higher body mass index (BMI) and SARC-F score, lower handgrip (upper limb) and lower limb strength, as well as slower gait speed (all p-value <0.05).

The association between fatigue severity and sarcopenia measures is shown in Table 2. In Model 1 for unadjusted logistic regression analysis, fatigue severity was significantly associated with SARC-F score (OR = 1.584, 95% CI = 1.263-1.986, p-value = 0.001) and CC (OR = 1.101, 95% CI = 1.012-1.205, p-value = 0.025). Meanwhile, in Model 2 after adjusting for age, fatigue severity remained significantly associated with SARC-F score (OR = 1.583, 95% CI = 1.262-1.986, p-value = 0.001) and CC (OR = 1.103, 95% CI = 1.014-1.200, p-value = 0.022). Model 3 was performed by removing the SARC-F score, while analysis showed CC (OR = 1.088, 95% CI = 1.006-1.178, p-value = 0.036) and gait speed (OR = 0.011, 95% CI = 0.001-0.168, p-value = 0.001) were significantly associated with fatigue severity after adjusting for age.

Discussion

Based on the results, there was an association between self-reported fatigue and sarcopenia measures (SARC-F score, MM, CC, upper (handgrip), and lower

Table 1. Comparisons of Characteristics among Elderly with Mild and Severe Fatigue (n = 201)

Variable	(Mean ± SD)			p-value
	Total (n = 201)	Mild Fatigue (n = 144)	Severe Fatigue (n = 57)	
Age	68.45±6.30	67.65±5.89	70.46±6.87	0.004**
Gender				0.499
Male	97	70	27	
Female	104	74	30	
Height (cm)	160.22±9.26	159.91±9.23	161.00±9.38	0.456
Weight (kg)	69.08±13.21	67.05±12.45	74.23±13.95	0.001**
Body mass index (kg/m^2)	26.91±4.67	26.15 ± 4.10	28.82±5.45	0.001**
SARC-F score	1.77±2.04	1.19±1.61	3.21±2.28	0.001**
MM (ASM/height^2)	6.44±1.31	6.46±1.31	6.38±1.32	0.709
CC (cm)	33.99±5.33	34.02±4.95	35.60 ± 6.19	0.060
UL strength (kg)	25.34±11.028	26.35±11.32	22.77±9.86	0.038*
LL strength (s)	14.59±6.94	13.68±6.95	16.87±6.43	0.038*
Gait speed (m/s)	0.54±0.18	0.57±0.16	0.44±0.17	0.001**

Notes: CC: Calf Circumference; UL: Upper Limb; LL: Lower Limb; ASM: Appendicular Skeletal Muscle Mass, SD: Standard Deviation. Independent t-test; *significant at p-value < 0.05; **significant at p-value < 0.01. The gender difference was compared using a χ^2 test.

Table 2. Multivariate Models for the Association of Sarcopenia Measures and Self-Reported Fatigue Severity among Elderly (n = 201)

Variable	Model 1			Model 2			Model 3		
	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value
SARC-F score	1.584	1.263-1.986	0.001**	1.583	1.262-1.986	0.001**	-	-	-
MM	0.842	0.588-1.205	0.346	0.861	0.589-1.241	0.422	0.898	0.635-1.271	0.545
CC	1.101	1.012-1.197	0.025*	1.103	1.014-1.200	0.022*	1.088	1.006-1.178	0.036*
UL strength	1.017	0.978-1.058	0.397	1.016	0.976-1.057	0.164	0.995	0.959-1.032	0.777
LL strength	0.994	0.938-1.054	0.831	0.993	0.937-1.052	0.801	0.999	0.948-1.052	0.966
Gait speed	0.119	0.007-2.068	0.226	0.170	0.008-3.419	0.358	0.011	0.001-0.168	0.001**

Notes: Model 1: Univariate analysis; Model 2: adjusted for age; Model 3: adjusted for age with SARC-F score removed.
CC: Calf Circumference; UL: Upper Limb; LL: Lower Limb; OR: Odds Ratio; CI: Confidence Interval.
*significant at p-value <0.05; **significant at p-value <0.01

limb strength, as well as gait speed). The prevalence of fatigue was 28.36%, which was higher compared to previous report measured using the CES-D scale in the community,[3] but lower compared to a report in the institution measured using FSS.[22] For the unadjusted model, only SARC-F score and CC were associated with self-reported fatigue. Meanwhile, after adjusting for age, the SARC-F score and CC remained significantly associated with fatigue severity. Model 3, which excluded the SARC-F score, but age-adjusted, showed that CC and gait speed were significantly associated with fatigue severity.

Furthermore, the results showed that elderly with severe fatigue have significantly higher SARC-F scores, weaker muscle strength (UL and LL), and slower gait speed. SARC-F was found to be consistently associated with fatigue even after adjustment for age. A previous study on cancer patients also found that fatigue, known to be related to cancer diagnosis and treatment, was significantly associated with the SARC-F score.[23] This was expected as the SARC-F questionnaire asked for the participants' performance on specific physical activities similar to the FSS which made both methods to be associated.

Regarding MM, measured using the bioelectrical impedance analysis (BIA), together with CC as a proxy for MM, there was no significant differences between elderly with mild and fatigue severity. This is probably due to the physiological decline resulting from aging process in the elderly. However, CC was consistently associated with fatigue severity in all the regression models. In contrast to a previous study, MM based on the skeletal muscle index was found to predict the level of fatigue.[24] This inconsistent result is probably because the participants in the previous study had cancer-related fatigue which might have a different mechanism of fatigue and sarcopenia, or in other words, the sarcopenia is due to secondary causes.[24] Secondary sarcopenia occurs as a result of both depletion of fat and muscular tissue either due to lack of vitamin D, insufficient food intake, decrease physical activity secondary to fatigue, as well as outcome of a direct effect of chemotherapy on muscular tissue.[25] Meanwhile, sarcopenia in the elderly primarily occurs due to changes in aging throughout life where there is a progressive decline in skeletal muscle strength and MM.[26] Neefjes, *et al.*,[24] found no significant differences in the level of fatigue with increased MM in women with advanced cancer signifying the probability of other factors that contribute to fatigue. It has been argued that exercise induces angiogenesis, thereby improving blood supply to the muscles,[27] hence, promote recovery of muscle fatigue.[28] The result was not in line with a previous study that found no significant relationship between muscle strength and fatigue level.[29] Meanwhile, this was expected as this study recruited individuals with Parkinson's disease which have a different underlying mechanism.[29]

This study also showed that the muscle strength of the UL and LL in the elderly with severe fatigue was significantly lower. The results were consistent with a previous study which reported a significant decline in grip strength (p-value <0.01) in the elderly that complained of fatigue resulting in reduced physical performance.[30] Besides, LL strength was also found to be lower in a previous study that used the 5-Step Test to measure the time (in second). It took five times, for the participants to go up and down a 10.1 cm wooden platform. Similarly, Gacesa, *et al.*,[31] observed a decremental pattern in the level of muscle fatigue as opposed to an incremental pattern in muscle strength following four weeks of strength training (fatigue decreased from 38.9+8.6% to 12.4+0.7%; muscle strength increased from 660.0+112.3% to 839.5+125.5%, respectively). The results showed a significant association between fatigue level and muscle strength indicating that a higher level of muscle strength results in a lower level of fatigue. This is in line with the current study which found a lower level of fatigue in the elderly with a higher LL strength. Strength training causes an increase in skeletal muscle adaptations, which resultantly increase muscle ability to generate power and force to execute functional tasks thereby decreasing fatigue.[31]

Furthermore, increased recruitment of new motor units along with an increase in cellular metabolic control improves the energy level and efficiency of energy consumption necessary for muscle contractions.[31] In contrast, this study found that none of these muscle strength measures were significantly associated with fatigue severity. Measuring LL strength using the FSTS was not recommended by the AWGS as it tends to reflect multicomplex pathologies.[15] Therefore, it is suggested that measures of strength must not directly influence fatigue severity as the item asked in FSS including physical function as well as physical, work, and social activities are more geared towards physical performance. This also explains why the SARC-F score and gait speed were more likely to be associated with fatigue severity as the measures indicate activities related to physical performances.[23]

Concerning gait speed, the elderly that reported fatigue took a longer time to complete the test indicating lower physical performance. This was supported by a previous study which found that gait speed as one of the components in the SPPB scale was associated with self-reported fatigue, however, in this study, fatigue was measured based on the CES-D scale.[3] These findings occured because the elderly that reported fatigue tend to have reduced walking speed, which might also be due to weakness of the lower limb as shown by a longer time complete the test which resultantly led to a reduced muscle force production needed to initiate walking movement. Hence, fatigue is an essential factor which directly or indirectly affect the elderly's physical performances. Based on the results, there was a difference in the level of fatigue and physical performance (gait speed) in line with a previous study reported that elderly who complained of fatigue display poorer health and lower physical performance compared to non-fatigued.[32]

There are a few limitations that need to be addressed in this study. The small sample size makes it difficult to find significant differences between fatigue and sarcopenia among the elderly. In addition, the participants consisted of only 201 elderlies from a few selected locations in Selangor, Malaysia, hence, the findings from this study is not generalizable to all entire elderly population in Malaysia as the level of fatigue might be affected by secondary factors such as pain, long-term medical illnesses, emotional distress or personal lifestyles.[33] Also, causalities are not assumable as this is a cross-sectional study. The purposeful sampling method was used to collect data hence, the results might not be the actual representation of the populations. In future studies, fatigue is expected to be conceptualized through two different definitions, namely perception of fatigue and as well as, fatigability and objective changes that occur in response to neuromuscular system activation.[34]

Conclusion

In conclusion, fatigue severity is associated with perceived sarcopenia as measured by the SARC-F questionnaire, CC and gait speed. The severely fatigued elderly demonstrate lower muscle mass, higher SARC-F score, lower muscle strength, and slower gait speed. In addition, muscle mass and gait speed are associated with fatigue. The findings of this study have implication on the practice of physiotherapists to include sarcopenia and fatigue measures when dealing with elderly. Intervention for elderly should also target the sarcopenia indicators to improve the physical tolerance or to reduce the perception of fatigue.

Abbreviations

FSS: Fatigue Severity Scale; CC: Calf Circumference; CES-D: Centre for Epidemiologic Studies-Depression; SPPB: Short Physical Performance Battery; EWGSOP: European Working Group for Sarcopenia in Older People; MM: Muscle Mass; AWGS: Asian Working Group for Sarcopenia; ASM: Appendicular Skeletal Muscle Mass; ASMI: Appendicular Skeletal Mass Index; LL: Lower Limb; UL: Upper limb; FSTS: Five Times Sit-to-Stand test; MWT: Meter Walk Test; BMI: Body Mass Index.

Ethics Approval and Consent to Participate

Written informed consent was obtained from all participants, meanwhile an ethical approval was obtained from the Research Ethics Committee, Universiti Teknologi MARA Malaysia.

Competing Interest

The author declares that there are no significant competing financial, professional, or personal interests that might have affected the performance or presentation of the work described in this manuscript.

Availability of Data and Materials

Not Applicable

Authors' Contribution

MJ and AL conceptualized the study design, contributed to data analysis, interpreted the results, drafted the manuscript, and approved the final copy of the manuscript. Meanwhile, NN, AJ, II, MSAF, and DE conducted data collection and management and helped prepare the manuscript. All authors read and approved the final version of the manuscript.

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